CLAIMS

What is claimed is:

1. A cationic graft-copolymer of a water-soluble linear backbone polymer having hydroxyl groups, for a non-viral gene delivery vector, comprising a unit derived from a cationic water-soluble linear polysaccharide of the following formula (1)

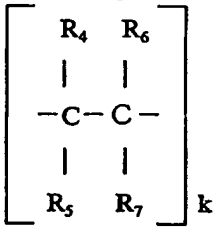
$[C_6H_7O_2(OH)_{3-a}(OX)_a]_xH_2O$ (1)

or a unit derived from a water-soluble linear polyvinylalcohol of the following formula (2) or a partial hydrolyzed alcohol of the following formula (3)

$-[CH_2CH(OH)_{1-b}(OX)_b]_n-$ (2)

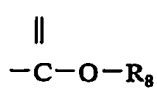
$-[CH_2CH(OH)_{1-b-c}(OX)_b(OAc)_c]_n-$ (3)

Wherein X is a $-(CH_2)_m R_1$ organic radical where R_1 is a member of the class consisting of $-NH_2$ radical, $-N(CH_3)_2$ radical, $-N(C_2H_5)_2$ radical, $-N^+(C_2H_5)_3$ radical, $-N^+(CH_2)_2CH_2CH(OH)CH_3$ radical, $-N^+(C_2H_5)_2CH_2CH(OH)CH_3$ radical, $-N^+(C_2H_5)_2(C_2H_5)N(C_2H_5)_2$ radical, $-C_6H_4NH_2$ radical, and $-COC_6H_4NH_2$ radical, $-COR_2$ radical where R_2 is $-CH_2NH_2$ or $-C_6H_4NH_2$, $-CH_2CH(OH)CH_2R_3$ radical where R_3 is $-NH_2$, $-N(CH_3)_2$, $-N(C_2H_5)_2$, and $-N^+(C_2H_5)_3$ radical, m is a natural number of 1 to 3, a is a positive number having a value of $0<a<3$, b is a positive number having a value of $0<b<1$, x and n are natural numbers having a value of 5 or more, $1>b+c$, and Ac is acetyl radical; and a unit derived from a polymerize-able olefin compound of the following formula (4)



(4)

Wherein R_4, R_5 and R_6 are each selected from the group consisting of hydrogen and CH_3 and R_7 is a member of the group consisting of



Where R_8 is a member of the class consisting of hydrogen, C_1-C_{12} alkyl radicals, cyclohexyl radical, C_1-C_4 hydroxyalkyl radicals, C_1-C_8 aminoalkyl radicals, C_1-C_8 dialkylaminoalkyl radicals, glycidyl radical, tetrahydrofuran radical, C_1-C_4 lower alkyl -substituted tetrahydrofuran radical, benzyl radical, the $(CH_2CH_2O)_y CH_2CH_2OH$ radical where y is a positive integer from 1 to 10,and $-N(R_9)_2$ where the two R_9,s which may be the same or different, are

either hydrogen or a C_1-C_4 alkyl radical;

$$-C-CN;\ -OH;\ -C-R_{10}$$

Where R_{10} is a C_1-C_8 alkyl radical; phenyl radical; tolyl radical; pyridine radical; pyrrolidone radical; and

$$-C-R_{11}$$

Where R_{11} is NH_2, $NHCH_3$, N,N-dimethylamino radical, N,N-dimethylaminopropylamino radical, and morpholine radical.

2. A process for preparing a cationic graft-copolymer of a water-soluble linear backbone polymer having hydroxyl groups, for a non-viral gene delivery vector, which comprises reacting a cationic water-soluble linear polysaccharide of the following formula (1)

$[C_6H_7O_2(OH)_{3-a}(OX)_a]_xH_2O$ (1)

or a unit derived from a water-soluble linear polyvinylalcohol of the following formula (2) or a partial hydrolyzed alcohol of the following formula (3)

$-[CH_2CH(OH)_{1-b}(OX)_b]_n-$ (2)

$-[CH_2CH(OH)_{1-b-c}(OX)_b(OAc)_c]_n-$ (3)

Wherein X is a $-(CH_2)_mR_1$ organic radical where R_1 is a member of the class consisting of $-NH_2$ radical, $-N(CH_3)_2$ radical, $-N(C_2H_5)_2$ radical, $-N^+(C_2H_5)_3$ radical, $-N^+(CH_2)_2CH_2CH(OH)CH_3$ radical, $-N^+(C_2H_5)_2CH_2CH(OH)CH_3$ radical, $-N^+(C_2H_5)_2(C_2H_5)N(C_2H_5)_2$ radical, $-C_6H_4NH_2$ radical, and $-COC_6H_4NH_2$ radical, $-COR_2$ radical where R_2 is $-CH_2NH_2$ or $-C_6H_4NH_2$, $-CH_2CH(OH)CH_2R_3$ radical where R_3 is $-NH_2$, $-N(CH_3)_2$, $-N(C_2H_5)_2$, and $-N^+(C_2H_5)_3$ radical, m is a natural number of 1 to 3, a is a positive number having a value of $0<a<3$, b is a positive number having a value of $0<b<1$, x and n are natural numbers having a value of 5 or more, $1>b+c$, and Ac is acetyl radical; with a polymerize-able olefin compound of the formula (4')

$$\begin{array}{cc} R_4 & R_6 \\ | & | \\ C & = C \\ | & | \\ R_5 & R_7 \end{array} \quad (4')$$

Wherein R_4, R_5 and R_6 are each selected from the group consisting of hydrogen and CH_3

and R_7 is a member of the group consisting of

$$-C(=O)-O-R_8$$

Where R_8 is a member of the class consisting of hydrogen, C_1-C_{12} alkyl radicals, cyclohexyl radical, C_1-C_4 hydroxyalkyl radicals, C_1-C_8 aminoalkyl radicals, C_1-C_8 dialkylaminoalkyl radicals, glycidyl radical, tetrahydrofuran radical, C_1-C_4 lower alkyl -substituted tetrahydrofuran radical, benzyl radical, the $(CH_2CH_2O)_y CH_2CH_2OH$ radical where y is a positive integer from 1 to 10,and $-N(R_9)_2$ where the two R_9,s which may be the same or different, are either hydrogen or a C_1-C_4 alkyl radical;

$$-C(=O)-CN;\ -OH;-C(=O)-R_{10}$$

Where R_{10} is a C_1-C_8 alkyl radical; phenyl radical; tolyl radical; pyridine radical; pyrrolidone radical; and

$$-C(=O)-R_{11}$$

Where R_{11} is NH_2, $NHCH_3$, N,N-dimethylamino radical, N,N-dimethylaminopropylamino radical, and morpholine radical.

3. A complex between a cationic graft-copolymer of a water-soluble linear backbone polymer having hydroxyl groups and DNA, comprising a unit derived from a cationic water-soluble linear polysaccharide of the following formula (1)

$$[C_6H_7O_2(OH)_{3-a}(OX)_a]_xH_2O \quad (1)$$

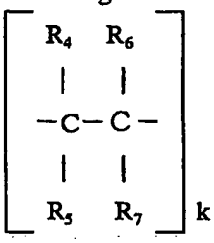
or a unit derived from a water-soluble linear polyvinylalcohol of the following formula (2) or a partial hydrolyzed alcohol of the following formula (3)

$$-[CH_2CH(OH)_{1-b}(OX)_b]_n- \quad (2)$$

$$-[CH_2CH(OH)_{1-b-c}(OX)_b(OAc)_c]_n- \quad (3)$$

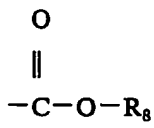
Wherein X is a $-(CH_2)_m R_1$ organic radical where R_1 is a member of the class consisting of $-NH_3^+$ radical, $-NH^+(CH_3)_2$ radical, $-NH^+(C_2H_5)_2$ radical, $-N^+(C_2H_5)_3$ radical, $-N^+(CH_2)_2CH_2CH(OH)CH_3$ radical, $-N^+(C_2H_5)_2CH_2CH(OH)CH_3$ radical, $-N^+(C_2H_5)_2(C_2H_5)N(C_2H_5)_2$ radical, $-C_6H_4NH_3^+$ radical, and $-COC_6H_4NH_3^+$ radical, $-COR_2$ radical where R_2 is $-CH_2NH_3^+$ or $-C_6H_4NH_3^+$, $-CH_2CH(OH)CH_2R_3$ radical

where R_3 is $-NH_3^+$, $-NH^+(CH_3)_2$, $-NH^+(C_2H_5)_2$, and $-N^+(C_2H_5)_3$ radical, m is a natural number of 1 to 3, a is a positive number having a value of $0<a<3$, b is a positive number having a value of $0<b<1$, x and n are natural numbers having a value of 5 or more, $1>b+c$, and Ac is acetyl radical; a unit derived from a polymerize-able olefin compound of the following formula (4)

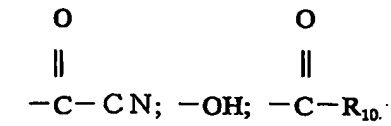


(4)

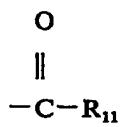
Wherein R_4, R_5 and R_6 are each selected from the group consisting of hydrogen and CH_3 and R_7 is a member of the group consisting of



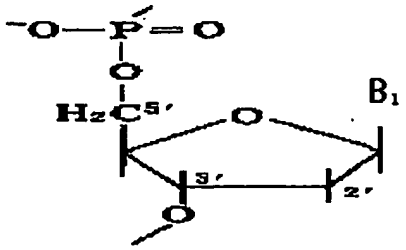
Where R_8 is a member of the class consisting of hydrogen, C_1-C_{12} alkyl radicals, cyclohexyl radical, C_1-C_4 hydroxyalkyl radicals, C_1-C_8 aminoalkyl radicals, C_1-C_8 dialkylaminoalkyl radicals, glycidyl radical, tetrahydrofuran radical, C_1-C_4 lower alkyl -substituted tetrahydrofuran radical, benzyl radical, the $(CH_2CH_2O)_y CH_2CH_2OH$ radical where y is a positive integer from 1 to 10,and $-N(R_9)_2$ where the two R_9,s which may be the same or different, are either hydrogen or a C_1-C_4 alkyl radical;



Where R_{10} is a C_1-C_8 alkyl radical; phenyl radical; tolyl radical; pyridine radical; pyrrolidone radical; and



Where R_{11} is NH_2, $NHCH_3$, N,N-dimethylamino radical, N,N-dimethylaminopropylamino radical, and morpholine radical; and a unit derived from a poly(deoxyribonucleotide) of the following formula (5) as a recurring unit.



(5)

Where B_1 is a base selected from the group of adenine, thymine, guanine, and cytosine.

4. A complex between a cationic graft-copolymer of a water-soluble linear backbone polymer having hydroxyl groups and RNA, comprising a unit derived from a cationic water-soluble linear polysaccharide of the following formula (1)

$[C_6H_7O_2(OH)_{3-a}(OX)_a]_xH_2O$ (1)

or a unit derived from a water-soluble linear polyvinylalcohol of the following formula (2) or a partial hydrolyzed alcohol of the following formula (3)

$-[CH_2CH(OH)_{1-b}(OX)_b]_n-$ (2)

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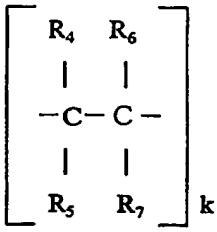

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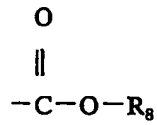
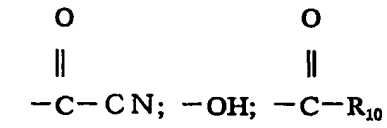
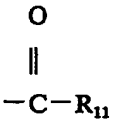


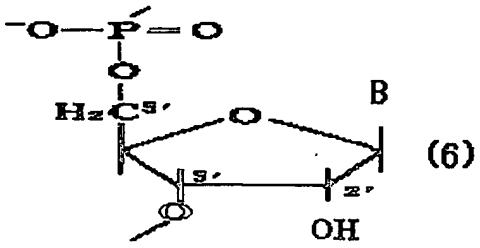
Where R_8 is a member of the class consisting of hydrogen, C_1 $-C_{12}$ alkyl radicals, cyclohexyl radical, C_1-C_4 hydroxyalkyl radicals, C_1-C_8 aminoalkyl radicals, C_1-C_8 dialkylaminoalkyl radicals, glycidyl radical, tetrahydrofuran radical, C_1-C_4 lower alkyl -substituted tetrahydrofuran radical, benzyl radical, the $(CH_2CH_2O)_y CH_2CH_2OH$ radical where y is a positive integer from 1 to 10,and $-N(R_9)_2$ where the two R_9,s which may be the same or different, are either hydrogen or a C_1-C_4 alkyl radical;



Where R_{10} is a C_1-C_8 alkyl radical; phenyl radical; tolyl radical; pyridine radical; pyrrolidone radical; and



Where R_{11} is NH_2, $NHCH_3$, N,N-dimethylamino radical, N,N-dimethylaminopropylamino radical, and morpholine radical; and a unit derived from a poly(ribonucleotide) of the following formula(6) as a recurring unit.



(6)

Where B is a base selected from the group of adenine, uracil, guanine, and cytosine.

5. A gene delivery system using a complex between the cationic graft-copolymer and DNA, of Claim 3.
6. A gene delivery system using a complex between the cationic graft-copolymer and RNA, of Claim 4.